

Proposed 2007 Amendments to Phase 3 California Reformulated Gasoline Regulations

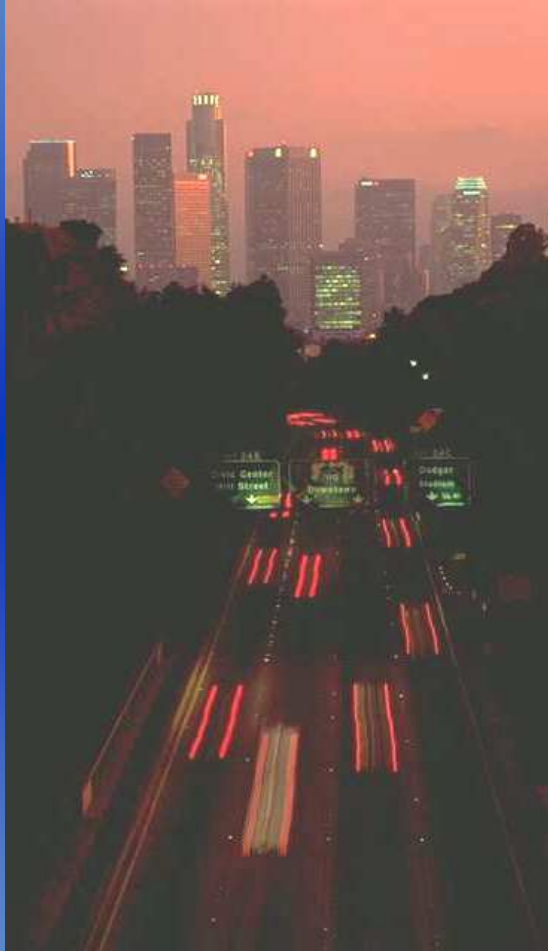
**Air Resources Board Meeting
June 14, 2007**

California Environmental Protection Agency



Air Resources Board

Outline



- ➡ Overview
- ➡ Background
- ➡ Proposed Amendments
 - Predictive Model
 - Regulations
- ➡ Impacts
- ➡ Public Comments
- ➡ Proposed Modifications
- ➡ Recommendations

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Overview

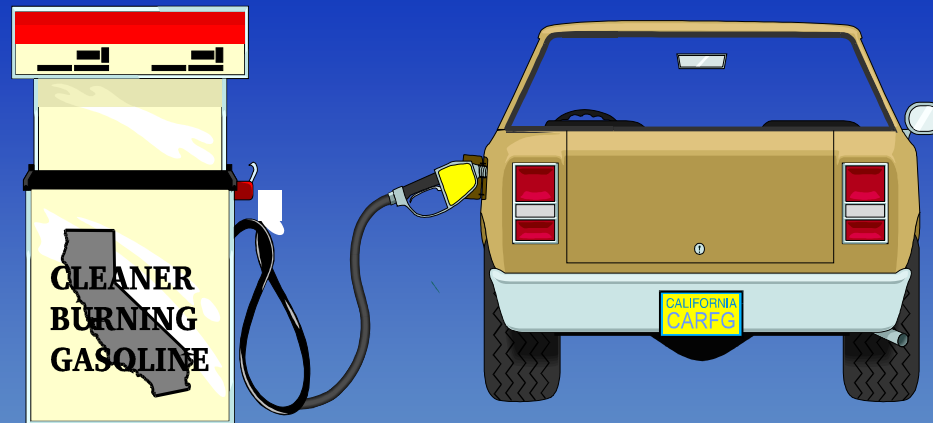
Basis for Proposed Action

- ➡ State law requires that gasoline containing ethanol must achieve the same emission benefits as gasoline containing MTBE
- ➡ Studies now show that ethanol use increases evaporative emissions due to permeation
- ➡ To meet State law, we must take action to preserve the emission benefits



Proposed Action

- ➡ Amend the CaRFG regulations
- ➡ Mitigate permeation emissions
- ➡ Update the California Predictive Model



Expected Outcome

- ➡ Mitigate the evaporative emissions increases caused by the replacement of MTBE with ethanol from on-road vehicles
- ➡ Increase the amount of ethanol in gasoline from 6% to 10%
- ➡ Reduce the sulfur content of gasoline
- ➡ Some refiners can produce compliant fuel by 2010; others need until 2012

Proposed Implementation

- ➡ **Require all fuel producers to mitigate emissions increases by 2010 using:**
 - Updated predictive model, or
 - Alternative emissions reduction plan (AERP)
- ➡ **Require all fuel producers to mitigate emission increases using fully compliant fuels by 2012**

Benefits



- ➡ **Preserve benefits of gasoline use in on-road motor vehicles**
- ➡ **Improve the predictive model**
- ➡ **Enable higher ethanol use**
- ➡ **Provide additional flexibility to fuel producers**

Cost Impacts

- ➡ Increase capital costs by \$0.4 – \$1.0 billion
- ➡ Increase production cost 0.6 – 2.1 cents/gal
- ➡ Decrease fuel economy by 1.3%
- ➡ Increase driving costs by 2%



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Background

California Phase 2 Reformulated Gasoline Program

- ➡ Phase 2 gasoline implemented in 1996
- ➡ Set standards for 8 gasoline properties
- ➡ Two options used to comply:
 - Meet specified “flat” or “averaging” limits
 - Use California Predictive Model to set alternative specs
- ➡ “Cap” limit also set for each property
- ➡ Resulted in increased use of oxygenate methyl tertiary-butyl ether (MTBE)

MTBE in Groundwater

- ➡ MTBE in groundwater soon discovered
- ➡ State law directed the ARB to phase-out MTBE
- ➡ Ethanol identified as only option to MTBE
 - Federal requirement for oxygen use in RFG
- ➡ State law required that emissions benefits be preserved



California Phase 3 Reformulated Gasoline Program



- ➡ Adopted in 1999; amended in 2002
- ➡ Implemented MTBE ban in 2004
- ➡ Facilitated increased use of ethanol
- ➡ Updated Predictive Model
- ➡ Directed staff to investigate impacts of ethanol on evaporative emissions

Permeation Emissions from On-Road Sources

- ➡ **Coordinating Research Council concluded that ethanol fuel increases permeation emissions by 65 percent**
 - Compared to MTBE-containing fuel
 - Studies for on-road motor vehicles only
- ➡ **Permeation increases evaporative emissions by allowing fuel molecules to pass through the materials of a source's fuel system**

Permeation Emissions On-Road Motor Vehicles (High Ozone Days)

Year	Permeation Emissions (tons/day)
2005	28.8
2010	18.4
2015	12.1
2020	8.1

Source: EMFAC2007

Permeation Emissions from Off-Road Sources

- ➡ Sources include lawn mowers, string trimmers, pleasure craft, gas cans, etc
- ➡ Emissions impact significant but uncertain at this time
- ➡ Studies underway to quantify impact
- ➡ Initial results expected in early 2008



What is the Predictive Model?


- ➡ Introduced in 1994 and updated in 1999 as a part of the MTBE phase-out
- ➡ Provides flexibility that allows
 - Lower production costs
 - Higher production volumes
 - No loss of environmental benefits
- ➡ Used to produce over 90% of today's gasoline

Features of the Predictive Model

- ➡ Mathematical models that relate vehicle emission of key pollutants to changes in fuel properties
- ➡ Based on thousands of emission tests
- ➡ Compares alternative specifications to a set of reference specifications
- ➡ Alternative specifications must achieve the same or better benefits for the following:
 - ozone-forming potential
 - oxides of nitrogen, and
 - toxics









Proposed Changes to the California Predictive Model



Modify Model to Mitigate Permeation Emissions

- ➡ **Model updated to explicitly include permeation emissions from on-road sources**
- ➡ **Amounts to about 18 tpd in 2010 and 12 tpd of evaporative HC increase in 2015**

Technical Updates to Improve the Predictive Model

-  **Add new emissions test data**
-  **Update reactivity adjustment factors**
-  **Update the vehicle age distribution to reflect 2015 vehicle fleet**
-  **Update the CO model**
-  **Adjust application of RVP Limit**
-  **Allow oxygen content flexibility**

Effect of Proposed Updates

Relative to previous model:

- ➡ Permeation emissions now included; compliant fuels need to further reduce exhaust emissions
- ➡ Emissions of ozone forming VOCs and CO are more sensitive to oxygen content
- ➡ Very low sulfur has more effect on reducing NOx from newer vehicles

Impact on Fuel Producers

- ➡ Existing fuel formulas will be modified
 - Increase ethanol use from 6% to 10%
 - Reduce sulfur content
- ➡ Most refiners will need to make capital investments to produce compliant fuel
- ➡ Some refiners can produce compliant fuel with minor modifications
- ➡ Pipeline operators need to add ethanol capacity



Proposed Amendments to the Reformulated Gasoline Regulations

Require Mitigation of Permeation Emissions

- ➡ **Require fuel producers to mitigate permeation emissions beginning 2010**
- ➡ **Two options available:**
 - Use the updated predictive model, or
 - Use an Alternative Emissions Reduction Plan
- ➡ **In 2010 permeation emissions are estimated to be 18 tpd**
- ➡ **Beginning 2012, producers must use updated predictive model**

Proposed Alternative Emissions Reduction Plan for Producers

Producers:

- ➡ Propose plan to mitigate emissions from other sources**
- ➡ Determine emissions debit that must be offset using the updated Predictive Model**
- ➡ Describe and demonstrate the type of program that will provide necessary emission reductions**

Proposed Alternative Emissions Reduction Plan for Producers

(continued)

- ➡ Applications are submitted to the Executive Officer for approval**
- ➡ Application packages available for 30 day public comment period**
- ➡ Sunsets in 2012**
- ➡ Producers would be allowed to apply for one year extension, if necessary**

Lower the Sulfur Cap

- ➡ Lower cap from 30 ppmw to 20 ppmw
- ➡ With 10% ethanol blends, producers fuel formulas with sulfur above 20 ppmw will not pass the Predictive Model
- ➡ Lower cap:
 - Increases enforceability
 - Protects performance of sulfur sensitive emissions control components
 - Allows for introduction of new technology

Allow Emissions Averaging for Low Sulfur Blends

- ☞ Compliance margins tight for low sulfur fuels**
- ☞ Slightly higher than intended sulfur levels may impact production**
- ☞ Option for emissions averaging provides flexibility**
- ☞ Producers must produce lower emitting fuel formulas that mitigate emissions impact within 90 days**
- ☞ Reporting and enforcement similar to existing averaging provisions**

Miscellaneous Amendments



- ☞ Change the maximum ethanol denaturant content specification from 4.76 percent by volume to 5.00 percent by volume
 - Consistent with recent change in ASTM D4806-06c
- ☞ Adopt current version of ASTM D4815-04
 - Test method for determining oxygenate content of gasoline



Impacts of Proposed Amendments

Impacts of Proposed Amendments on Emissions

Main Impacts:

- ➡ Mitigates the increase of permeation emissions from on-road sources
- ➡ Requires mitigation as early as possible beginning 2010
- ➡ Helps enable Low Carbon Fuel Standard

Impacts of Proposed Amendments on Emissions

(continued)

Secondary Impacts:

- ☞ Slightly increases criteria pollutant emissions from additional truck traffic**
- ☞ Slightly increases (<0.01 percent) CO₂ eq. emissions from refineries to produce fuel**
- ☞ Creates overall decreases of CO₂ eq. emissions considering fuel use and production**

Impacts of Proposed Amendments on Production

- ➡ Met with individual refiners and CEC
- ➡ Production would decrease 4-7 percent with no refinery modifications
- ➡ Production increases 3-10 percent with refinery modifications
- ➡ Capital investment projects expected to take approximately 4 years



Impacts of Proposed Amendments on Production

(Continued)

- ➡ AERP developed to enable earlier mitigation and facilitate compliance**
- ➡ With AERP, mitigation of permeation effects possible by 2010 with no production effects**
- ➡ Without AERP, full mitigation delayed until 2012 without a reduction in production**

Impacts of Proposed Amendments on Production Costs



- ➡ Capital costs originally estimated to be \$200 to \$400 million
(0.3 to 0.8 cents per gallon)
- ➡ Updated capital cost estimated to be 0.4 to \$1 billion
(0.8 to 1.4 cents per gallon)

Economic Impacts: Fuel Economy Penalty

- ➡ 1.3 percent decrease in fuel economy due to lower energy content of ethanol
- ➡ Consumer cost about 4 cents per gallon, or about \$15 to \$30 per year (assumes more ethanol use does not affect the fuel price)



Economic Impacts: AERP Costs

- Example Refiner with 10% of CA gas production
- Assume producers use the Accelerated Vehicle Retirement Program
- Require 29,000 retired vehicles to offset about 1.8 tpd of permeation emissions
- At \$750 per retired vehicle, the AERP cost would be approximately \$22 million, or about 0.5 cents per gallon
- Other options possible: gas can replacement or lawn equipment upgrades

Economic Impacts: Typical Driver

☞ For a typical driver:

- Production cost \$11 to \$16 per year
- Fuel economy cost \$16 to \$30 per year



☞ Total cost to consumer is about \$30 to \$50 per year

Multimedia Evaluation

- ➡ Completed in January 2000 for ethanol blends up to 10 percent
- ➡ No change in either flat or averaging limits
- ➡ No cause for any fuel property to exceed cap limits evaluated in 2000
- ➡ Does not change findings from 2000 multimedia evaluation
- ➡ No need to conduct new multimedia evaluation

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Public Comments

Fuel Industry Comments

- ➡ Do not implement the regulation until 2012 to allow full 4 years for refinery upgrades
- ➡ Delete the AERP and seek an alternative solution to early mitigation
- ➡ Lower/raise the proposed sulfur cap
- ➡ Extend the sulfur cap compliance date
- ➡ Allow for early blending of higher ethanol blends
- ➡ Consider the impact of the CEC's ongoing refinery modeling work

Fuel Industry Comments

(continued)

- ➡ Consider different technical approach to evaluating the NOx response to sulfur in newer vehicles
- ➡ Consider different technical approach to evaluating the data for Tech 4 vehicles
- ➡ Work with companies on CEQA/permitting issues
- ➡ Review the regulation as part of the low carbon fuel standard rulemaking

Peer Reviewers

- ☞ To evaluate the scientific basis, staff contracted through the University of California for an independent peer review
- ☞ Peer reviewers:
 - Dr. Joost de Gouw, NOAA Earth System Research Laboratory
 - Professor Allen Robinson, Carnegie Mellon University
 - Professor William R. Stockwell, Howard University
 - David D. Geddes, PREP Consulting, Inc

Peer Reviewer Comments

- ➡ Reviewers agreed in general with ARB staff's evaluation of the scientific basis of amendments and emissions
- ➡ A more thorough study of the impact of CaRFG on GHG emissions is suggested
- ➡ Quantifying uncertainty of model is suggested



Staff's Proposed Modifications

Staff's Proposed Modifications

- ➡ Allow third parties who are not producers or importers to enter into alternative reduction plans
- ➡ Implement lower sulfur cap in 2012 rather than 2010

Staff's Proposed Modifications

(continued)

- ➡ **Provide for an option for the early blending of higher ethanol provided emissions impacts are mitigated**
 - Allow for early access to AERP option
- ➡ **Update the Predictive Model Procedures Guide**



Recommendations

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**Approve the proposal with staff's
proposed modifications**

Recommendations

(continued)

Direct the staff to:

- ➡ Complete off-road studies and take appropriate action based on the results**
- ➡ Review the regulation as part of the low carbon fuel standard rulemaking**
- ➡ Work with the companies on CEQA/permitting issues**
- ➡ Propose amendments if acceptable alternative to the AERP enacted**
- ➡ Develop certification fuel**